

# Review Unit I

The Unity and Organization of Life

Monday, June 8, 2009

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## Living vs. Non-Living

- How do we know whether something is alive? Some basic guidelines:
  - Made of cells?
  - Use energy?
  - Able to reproduce?
  - Maintain stable internal environment?
    - Homeostasis
  - Contain genetic material?

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## Discovery of Cells and Development of Cell Theory

- Anton vanLeeuwenhoek/Robert Hooke
- Early microscopes to examine basic cells
- Cell Theory was put forward following the work of Shleiden and Schwann
- Electron microscope developed in 1940 allowed examinations of cells in great detail



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## Cell Theory

- The cell is the basic unit of structure of all living things
- The cell is the basic unit of function of all living things
- All cells come from pre-existing cells

Table 1-3 Historical Landmarks in Determining Cell Structure	
1665	Hooke uses a primitive microscope to describe small pores in sections of cork that he calls "cells."
1674	Leeuwenhoek reports his discovery of protists. Nine years later, he uses bacteria for the first time.
1833	Brown publishes his microscopic observations of orchids, clearly describing the cell nucleus.
1858	Schleiden and Schwann propose the cell theory, stating that the nucleated cell is the universal building block of plant and animal tissues.
1857	Kölliker describes mitochondria in muscle cells.
1879	Pfeffer describes with great clarity chromosome behavior during mitosis in animal cells.
1881	Cajal and other histologists develop staining methods that reveal the structure of nerve cells and the organization of neural tissue.
1898	Golgi first sees, and describes, the Golgi apparatus by staining cells with silver nitrate.
1902	Boveri links chromosomes and heredity by observing chromosome behavior during sexual reproduction.
1902	Pollak, Porter, and Sigmond develop methods of electron microscopy that enable many intracellular structures to be seen for the first time. In one of the first applications of these techniques, Huxley shows that muscle contains arrays of protein filaments—the first evidence of a cytoskeleton.
1957	Robertson describes the bilayer structure of the cell membrane, uses for the first time in the electron microscope.
1960	Kendrew describes the first detailed protein structure (myoglobin) to a resolution of 0.2 nm using X-ray crystallography. Perutz proposes a three-resolution structure for hemoglobin.
1968	Palmer and collaborators make the first medical microscope.
1974	Luxenho and Miller describe the use of fluorescent antibodies to stain the cytoskeleton.
1994	Chaffee and collaborators introduce green fluorescent protein (GFP) as a marker in microscopy.

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# Levels of Organization

- Cells
  - Contain specialized organelles that perform specialized functions
- Tissues
  - Group of cells of a single type performing together
- Organs
  - Multiple tissues working together
- Organ Systems
  - Multiple organs working together

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# Cellular Chemistry

- Life requires many organic materials
- Inorganic materials are also critical
  - Think water, oxygen
- Most must go through digestion before cells can access the nutrients
  - Ingestion>Digestion>Egestion

Organic Molecules and Digestive Products

Organic Molecule	Digestive End Product
Carbohydrate	Simple Sugars (glucose)
Lipid	Glycerol and Fatty Acids
Protein	Amino Acids

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# Cellular Transport

- Diffusion
  - Osmosis
  - Active Transport
- Passive Transport**

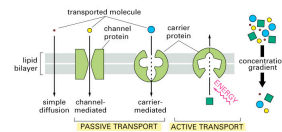


Figure 12-4. Campbell/Cell Biology, 3/e, © 2004 Garland Science

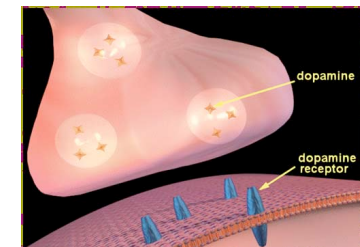
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# Cellular Communication

- Cells have receptors in their membranes to allow cell to cell and organ to cell communication
- Each receptor site is specific to only one shape of molecule
- Hormones and other molecules can be used as messengers



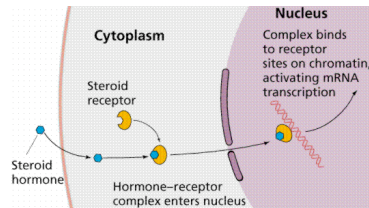
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# Hormonal Regulation

- Hormones produced in endocrine glands
- Hormones are chemicals released by specialized cells into the bloodstream
- Affect other cells by binding to their receptor sites and causing some response, often the release of another chemical
- Stomach enzymes, for example



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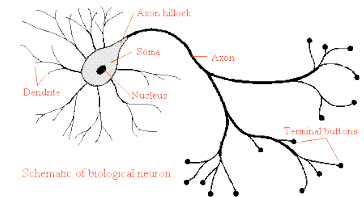
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# Nervous Regulation

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- Dorsal nerve cord with connecting neurons
- Neurons allow cells to communicate with one another very rapidly
- Nervous system responses allow response to a stimulus in multiple cells of an organism simultaneously
- Sensory neurons stimulate other neurons
- Motor neurons stimulate muscles



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# This Slide is a Spacer

- No new content beyond this point, only linked slides. Click the go back link to go back. Obviously.

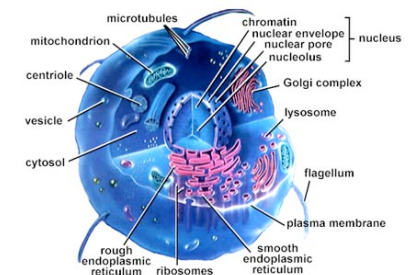
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# Cells

- The basic unit of structure and function for living things
- Range in size from 25 um to 1 mm
- All cells have a cell membrane and cytoplasm
- Many have nuclei (eukaryotes), mitochondria, ribosomes, golgi apparatus and more organelles
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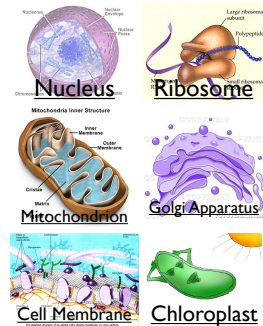


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## Some Organelles and Their Functions

- Most cells have more than one type of organelle
- Click on any organelle to view its function
- Organelles are critical to homeostasis at cellular level
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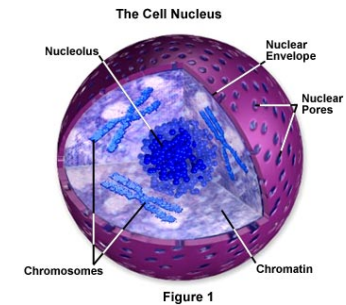


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## The Nucleus

- Control center of the cell
- Contains the genetic material, DNA
- Wrapped in a special membrane (the nuclear membrane) that keeps the DNA safe inside the nucleus but allows RNA to escape to the cell
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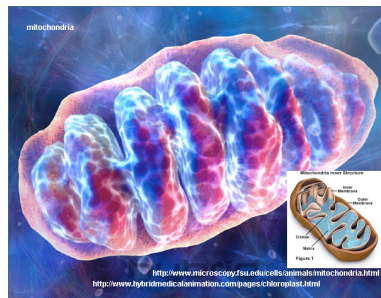


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## The Mitochondrion

- The powerhouse of the cell
- Found in high concentration in cells that require large amounts of energy
- Site of cellular respiration reactions
- Produce ATP, the cell's energy molecule from glucose and oxygen
- Contains its own DNA and can reproduce itself
- Too small to see with light microscope
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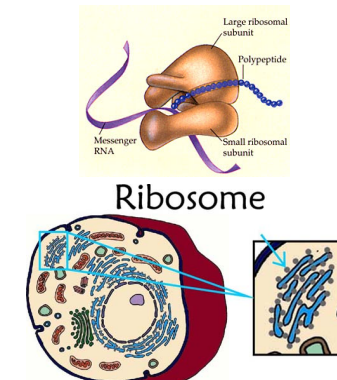


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## The Ribosome

- Site of protein production in cells
- Found free-floating, or bound to the rough endoplasmic reticulum
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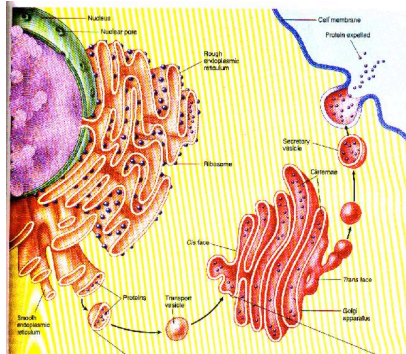
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## Golgi Apparatus (Also Golgi Body)

- A system of membranes that packages proteins up for transport out of the cell

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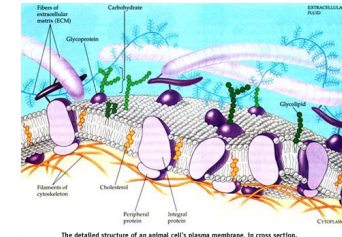


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## Cell Membrane

- A phospholipid bi-layer
- Semi-permeable
- Allows some substances to flow freely across it, like water
- Trans-membrane proteins
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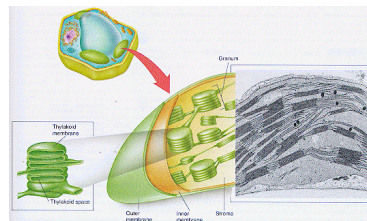


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## Chloroplast

- Similar in structure to mitochondria
- Contains stacks of membrane called grana
- Site of photosynthesis
- Chlorophyll gives them green color
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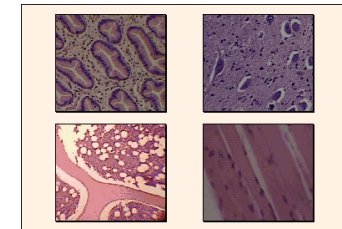


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## Tissues

- A group of similar cells that perform a similar function
- There are 4 main tissue types in the human body
- Connective, Muscle, Epithelial, Nervous
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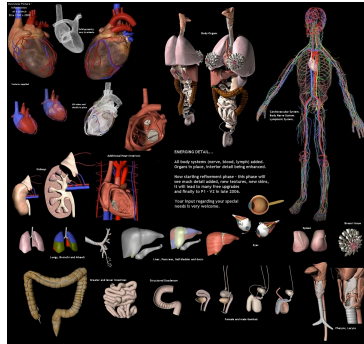


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# Organs

- Multiple tissues working together to perform a function (or a few functions)
- There are many major organs in the human body, including but not limited to the heart, brain, stomach, liver, large intestine, small intestine, kidney, bladder, eye, ear
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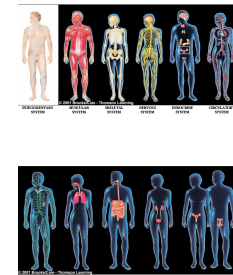


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# Organ Systems

- Multiple organs that work together to achieve a function
- There are 11 major organ system in humans including respiratory, circulatory, integumentary (skin), nervous, digestive, lymphatic, endocrine, muscular, skeletal, urinary, reproductive.
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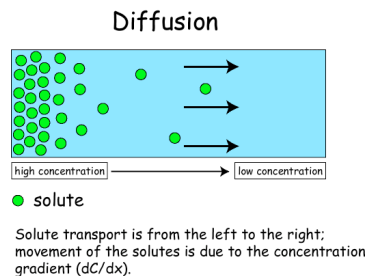


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# Diffusion

- Movement of molecules across a semi-permeable membrane from an area of high concentration to an area of low concentration
- No energy required
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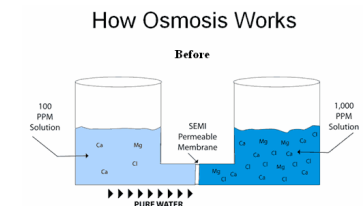


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# Osmosis

- The movement of water across a semi-permeable membrane from an area of high concentration to an area of low concentration
- No energy required
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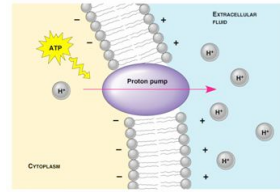


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# Active Transport

- Movement of molecules across a membrane from an area of low concentration to an area of high concentration
- Pumps against pressure
- Energy required
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# Life Processes

- [Digestion](#)
- [Respiration](#)
- [Locomotion](#)
- [Circulation](#)
- [Excretion](#)
- [Coordination](#)
- [Synthesis](#)
- [Immunity](#)

Metabolism

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# Digestion

- A process of breakdown of food items after ingestion (eating)
- Uses various enzymes and chemicals to reduce food items to parts useable by cells of the organism
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# Respiration

- Intake of oxygen to the body to drive cellular respiration and formation of maximum amount of ATP
- In cells, this occurs at the cell membrane via diffusion
- In animals, this occurs in the lungs
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# Locomotion

- Ability to move
- Cells use flagella or cilia to move
- Animals use appendages such as legs
- Some living things are immobile
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# Circulation

- The movement of fluids around the body of the organism
- Spreads nutrients to entire body
- In cells, cytoplasm flows freely
- In animals blood must be pumped actively
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# Excretion

- Removal of waste products from the body
- Cells use vacuoles to remove excess materials
- Animals have excretory systems
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# Coordination

- Control of bodily functions by a central control center
- In cells, control is performed by the nucleus
- In animals it is the job of the brain
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# Synthesis

- Creation of new body structures
- In cells, this is usually production of proteins from building blocks by ribosomes
- In animals, this is production of new body tissues
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# Immunity

- Ability of an organism to fight off infection by pathogens
- Cells use enzymes to digest pathogens
- Animals have immune systems
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# Metabolism

- The sum of all chemical reactions that occur in a cell
- Usually divided into 2 categories:
  - Breakdown of materials
  - Building of materials
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# Organic

- Any molecule that contains the element Carbon is usually considered organic (there are some exceptions, but if you see carbon in a compound, you better believe it will be organic!)
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